

THE VALUATION OF PIG IRON FOR FOUNDRY PURPOSES.

BY DR. RICHARD MOLDENKE, NEW YORK.

When I presented a memorial on this subject to the American Foundrymen's Association in convention in Boston, last June, I realized very fully that it was a radical step which was certain to be objected to by furnacemen generally. I did it to invite discussion, suggested a possible method of solving a problem which has long faced the foundryman who has to make castings for the severest service, and my only motive was to assist in raising the standard of the foundry trade another step higher.

It is very obvious that improvements should be made at every stage of the casting process. Then why not improve at the very starting point—the pig iron? We all realize that however we may specialize in our work, the jobbing foundry will always be with us, and no foundry pig iron worthy of the name need be left on the hands of its makers for want of work to cast it into. On the other hand, the founders of specialties, who have helped make this country so great as a manufacturing nation; these are entitled—nay more, should demand—perfection, as near as it can be attained, in their raw material. When they feel reasonably certain that they have the best pig iron obtainable, the best fuel, the most efficient melting processes, molding, pouring and cleaning outfits, then they will think again, and look for further economies and improvements. This is only the modern way of doing business,

superinduced by lively competition, and we are truly desirous of co-operating with the furnaces in every way possible to bringing about improved results.

It will be remembered that I proposed the study and subsequent adoption of standard methods of judging the value of pig iron for our purposes. I urged that the chemical standpoint, now so generally accepted, was not sufficient where the highest measure of quality in castings is concerned. That we cannot by chemical means trace the weakening influences of poor blast furnace practice, which may be diluted by judicious mixing with good irons, but which should be detected and the poor material weeded out absolutely for important and special work. That even the most uninformed foundryman today knows that it is useless to test iron in the pig direct, because of the wide variation in strength due to the cross section, pouring temperature, and treatment in the casting house. This outside of the furnace end of the proposition. It is therefore necessary to remelt this iron and to cast it into sufficient bars to get an idea as to its value for the work required. To do this with fairness and a reasonable chance of success, I recommended the use of a standard cupola, standard coke, standard conditions of charging, blast in fact the whole process accurately laid out, and standard test bars, possibly a dozen of them, from which to obtain the knowledge sought.

The foundry industry is much indebted to the *Iron Age* for sending out circular letters of inquiry with reference to my proposal, which, by the way, is only novel in the standardizing feature. In the issues of June 26th, and July 3rd, a number of replies are published, all of which give food for thought. In bringing out the subject, the *Iron Age* very rightly holds that the task is a prodigious one, and looks impossible, but that evidently American Foundrymen have something of this nature in mind and therefore approved of its further investigation.

The *Eisenzeitung*, of October 16, the official organ of the German Foundrymen, on the other hand, after giving the substance of the memorial, calls attention to the fact that German foundrymen have long felt the want of some such system, and urges concerted action to do something along the line indicated.

In studying the criticisms brought out by the *Iron Age*, the

interesting fact develops that there is a unanimous and settled willingness to sell pig iron by analysis. The work of our well known pioneers in foundry progress has thus revolutionized the old selling methods, for nowhere is fracture mentioned. For this much let us be thankful. No one would have thought this possible in the few years that have passed since grading by fracture was attacked. All the furnacemen on record think that selling pig iron by analysis is sufficient. They do not, however, realize that the roll maker, the founder of car wheels, the maker of malleable castings for specified tests, use several brands of the best irons obtainable, all of the proper composition, for safety; and when, in spite of this and the greatest care everywhere, the rolls crack, the car wheels fail to pass, and the couplers will not stand up, first one brand of iron is cut out and then another, and thus the hitherto unsuspected iron is weeded out. Doubtless this iron might be a very good one generally, but if the foundryman had the means of knowing that his shipments were made while the furnace was under a cloud, he would rather give away the iron than put it into large rolls. Such irons, while showing the right composition, might be so badly burned in the making that normally strong pigs will break in two by simply letting them fall on a rail. The cupola and the hearth furnaces are not the only places where iron can be badly oxidised, but this is very difficult to trace chemically.

One of my critics holds that skillful foundry practice overcomes some defects in a pig iron. True, judicious mixing will dilute excessive evils, but the foundryman is not desirous of paying full prices for this privilege. The very thing the method I proposed is intended for—the discovery of undue oxidation—cannot be eradicated by any foundry practice for cast iron we know of now.

Several critics do me the honor of holding that my proposition is correct theoretically, in fact ideal, if only possible to realize. That no progressive furnaceman has anything to fear from it, while the unprogressive one has, and depends upon a mixture of his with other good irons. It is suggested that enough bars be cast to make certain of a fair showing, and that the lines be not drawn too tight. All thinking foundrymen will heartily endorse this, for they will always give the fairest interpretation to the tests possible under the circumstances—provided they see an honest attempt to

deliver the best iron for the composition specified that can be made. I have never yet caused a single car load of iron to be removed from my yards. Whenever the standard was not met the price was revised, and the metal used for work of minor importance.

As there seems to be some misapprehension regarding the practical working of the physical test in addition to the chemical, it might be interesting to note how this will in all probability come about. The base price of a given iron will always be determined by the supply and demand, that is, ordinary market conditions. The founder who desires to have a guaranteed strength as per the test proposed, will naturally be expected to pay for it. This the founder of rolls, car wheels, malleables, government work, special machinery, and the list of other castings requiring the highest grade of materials will be glad to do. Wherever castings are made upon the strength and quality of which human life depends, there should be no question of price anyhow.

As the quantity of pig iron bought under such a test, at least for a long time to come, would be limited, there need be no serious interference with the yard arrangements at the furnaces, in fact I venture to prophesy that whenever a furnace has what is thought to be a specially good cast, it will be put to one side, tested, and the salesmen armed with the report for selling to an advantage. This is done right along in the chemical sense with irons specially suited for acid steel production. Why not then for car wheels?

It is further held that the physical strength is not enough, but that shrinkage, scrap carrying capacity, clean and sharp surface, and the microstructure of the iron should be arranged for. This I consider entirely too elaborate, and in fact unnecessary so far as we know now. The plain transverse test is all that is necessary to show what is required when taken in connection with the composition. The contraction of an iron when in the standard test bar, is practically a matter of its composition, and that mostly in the constitution of the carbons. With the large standard test bars, adopted by the American Foundrymen's Association, the influence of the pouring temperature and the molding sand is practically eliminated, leaving the question of contraction of much less importance than was formerly thought to be the case. Of course in the absence of

chemical data, a contraction test is very essential, but we are a little beyond that point at the present day.

So far as the scrap carrying capacity of an iron is concerned I have this much to say. This is also a factor of the composition. A high silicon iron will always carry more scrap than one that is low. My experience may differ from that of others, but I have always been able to hold the same percentage of scrap with any brand of iron of my required composition. I have found no difficulty in making castings from scrap alone when enough high silicon was added to get this element right, and enough manganese to cleanse the metal. I was rather astonished when told the other day that my experience in this line was way off, as the broker in question was selling pig iron comparatively low in silicon which was actually carrying 60 to 80 per cent. of scrap. He was in turn astonished when told that the scrap was carrying his pig iron. But he was laying great stress on graphite in pig iron, and did not think the other things mattered much. All of which shows that there is still room for missionary work in pig iron circles as well as in those of the foundry industry.

We all remember the time when furnaces refused to sell pig iron by analysis. Then a premium was asked, in one case presented to me it was \$2.00 a ton. Then the furnacemen yielded gracefully, and are now very glad to be rid of the grading disputes. Undoubtedly more attention is now given at the furnaces to turning out a more uniform product, big, densely graphitic pigs no longer helping out a low silicon cast. The result has been a direct benefit to the foundry trade as well as themselves. And so also will be the further improvement of the iron by increasing the demand for quality. The very earnest desire for a differentiation of the really good irons from the indifferent or really bad ones will not be thwarted by characterizing my proposal as "fundamentally wrong, unfair, impossible and undesirable." As "opening the doors to controversy. Only adapted for weak foundrymen," or asking too much "because steel men will not do it," and "foundrymen not educated enough to get any benefit from it." These tests, whether the one I proposed or other better ones, will come when furnacemen are ready to look for customers again, and then evidence of good qualities will be a good argument for sales.

It is admitted that poor foundry practice, bad fuel, or even

variations in the regular routine will bring about variations in results with the best of irons, that the character of the castings made from pig iron depends upon many conditions, but the fundamental idea remains that with good standards and fair conditions, a good iron should show up well in a remelting test. What the actual strength should be will soon be developed by the foundryman most interested, and gradually pig irons, while varying in composition from month to month, or day to day, as they come from the furnace, will not vary as much in corresponding quality as they do now.



THE FUTURE OF THE FOUNDRY INDUSTRY.

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But little thought is given to the future of our industry in these brisk times of orders in plenty. Our plants are yet crowded to their full capacity. Enlargements have been the rule up to now, but the projection of new enterprises has practically ceased. The only possible exception being in connection with established plants. This, then, seems the time to analyze the conditions which will affect the future of the foundry industry to a greater or less extent.

In the first place we must see what currents we are running in, and how they are drifting us along. In general we may say that specialization has become the order of the day. At the present time at least three quarters of the foundry output goes into channels within fixed and narrow bounds. This condition is not only likely to continue, but will become the national trade necessity. Specialization as against generalization is the sharp contrast we note in comparing our industrial system with that of Europe. Every one following out his own line of production to the extreme, learns the fine points which enable him to undersell at a profit. With our natural resources and transportation facilities, it is easy to see that careful nursing of the foreign trade we now enjoy, should do much to mitigate the disasters of the hard times to come.

With the tendency toward standardization of everything within reach, the future seems to indicate a still firmer grip for us upon the commerce of the world, and as specialization of effort is really the cause of our world power, I cannot think otherwise than that specialization and standardization together should be the key-note for our industry for the future.

Looking over the likely condition of the money market, it seems as if competition for work will sharpen considerably. Founders who have made connections which secure them preferences in

the way of holding work will be compelled to drop prices in spite of this, the outsider naturally leading the procession. Every founder will therefore try to get hold of something he can do better and cheaper than his fellow-townsmen. Some will succeed in this and keep their identity intact. The stronger ones will, however, be gradually drawn into working agreements with others in their line. From this actual combination is but a short step. This tendency which has made our present time one of huge industrial combination, will be still more accentuated in the future. Self defense will compel closer business relations so far as it affects the buying of materials from the great combination of other industries, and similarly the selling to the great combinations of still other industries. With these conditions properly balanced, and sufficient "independents" to make things interesting, there is not the same chance of extreme disasters in our industrial economy as heretofore.

We may therefore look for combinations in the heavy lines of foundry work, such as in car wheels, ingot molds, rolls, malleables, stoves and radiators, electrical work, and special lines of machinery. We already have working agreements, small combinations, and plans for larger ones in our industry. The tendency is therefore plain enough to see, and it will result in material changes in the actual operation of the plants.

There is a general feeling of confidence in industrial ventures, as reflected by the market for securities. Wall Street, ever discounting the future, is getting ready to list more and more industrial ventures of approved character and vast proportions, and thus facilitates the purchase and sale of securities in a bona fide way, where formerly it did so only for dynamiting purposes. While this may not be a good thing for our industry, as it usually means a lot of injected water and shaky financiering, yet it is a distinct gain to the country at large in affording wider channels for monetary interchange, and the direct necessity for capturing the foreign markets for the enormous production by capital which must earn dividends.

The result of all this is very far reaching, and is perhaps best seen in the last factor of the problem—the extreme pressure in our navy and ship building yards, and this brings us to the third item in the discussion—the labor problem.

We are undoubtedly going to face serious times with our labor conditions. Were only the interests of the foundry at stake we

might feel as if we are suffering for the good of the country. Unfortunately, however, the whole industrial system of the nation is bound to meet a crisis which will be delayed or hastened by conditions which may well give us grave concern. From the medieval times of the "Faustrecht" we have come to recognize that *Power* must be made to go with *Responsibility*. In other words, a breach of the peace, or a breach of contract is and can be properly punished in a normally constituted community. Moral wrongs, however, are perpetrated but too often, and must be met in another way.

We are daily seeing the breach between employer and employee growing wider, and this in spite of all that is done to bridge the chasm. Organizations which should naturally work in harmony are really formed to intensify the difficulty, and as between organized labor and organized capital, the crisis through which England has passed and lost its industrial supremacy, now faces us, and will next confront our chief competitor—Germany. Now what may the future have in store for us herein?

The invoking of law today, where barricades were the usual resort. The bitterness of the cry against "government by injunction" which shows that the right spot has been touched. All signs point to the will of the people, that power, whether in the hands of grasping corporations, or in large groups of workingmen, shall be coupled with responsibility. Imagine an industrial association wronging any one laborer without being sharply brought to account and mulcted heavy damages, and rightly so. When, however, an employer is all but ruined by tactics which are invariably denied but are practiced just the same by individual members of labor associations, he has the choice to fight or go under. Common justice demands that the parties of both parts be held liable to damages, and be made to obey the law without discrimination. The unscrupulous employer is just as much a menace to the country as the professional labor agitator.

We will therefore see the compulsory incorporation of organizations which aim to regulate the status of labor, and thus the "right of might" will be whipped into subjection to the highest welfare of the state. This may take some time, but it is sure to come. Our national organizations of foundry capital and foundry labor—yes, even the local ones eventually will be made responsible. Injury to the vested interests of our founders as well as breach of

contract with the men will be punishable, and eventually be of rare occurrence.

Then—and only then—will the real value of organized effort appear. And that is in the education of its constituent members. A labor union which instead of drawing up grievances and nominating shop committees, will teach its members to become more valuable to their employers, is a positive blessing to the country at large. An organization of employers which need not scheme how to circumvent impending demands and provide means to check violence and outrage to simple constitutional rights, would be a monument to the efficacy of our civic administration. Could the same effort and time be expended in improving conditions for labor in the foundry, another and most telling benefit would redound to our coveted permanent industrial surpency. And I predict that all this will come, in time, for it is the consequence of enlightenment and education. Only in this way will the moral wrongs of our industrial system be righted.

This brings us to another phase of the foundry labor question, and one which is more closely identified with the actual operating, the general aspect of the labor question being rather a matter of policy and finally an added expense to the buying public. The eight hour day has long been demanded, and I predict that it will come. Whether it will bring disaster to our industry, or will find us prepared to balance matters by suitable changes in our running methods, may well be worth our careful attention.

Personally, as a trained Mining Engineer, I favor the eight hour day, but—we must have three of these short days in every twenty four hours. The wise king, who held that eight hours were for work, eight for sleep, and eight for recreation, was perfectly right. It took many centuries to come near his ideal, but it will not be many more years before this is attained. However, if labor is to receive high returns for short hours, capital is no less entitled to take as heavy an income as these highly paid short hours can be made to yield. When I say that capital invested in the foundry should yield interest for twenty two and a half hours out of the twenty four, nearly every foundryman will throw up his hands and say, impossible! And yet this is exactly what many of them will have to arrange for or go out of business.

Do you note the general inquiry with reference to running the cupola continuously? You may not be aware that many foundries are already running two shifts and could easily arrange for three if there were molders enough available. The arbitrary arrangement of the apprentice question is bound to take a fall in the near future, and molders, good ones and plenty, will take work where it is offered. The solution of the whole future of the foundry lies in the molding machine and men with better all around foundry education.

Probably nine foundry men out of ten will tell you that night work is no good. I have never found this to be the case, but always enjoyed the sight of floor upon floor of molds ready to pour the first thing in the morning. With plants as light at night as in the day time, with proper organization, and short hours instead of the usual eleven hour night shifts, wonders of work can be accomplished.

That this is not theoretical may be seen from the actual fact that in the lumber industry the night gang is always able to turn out more material than the day men, hour for hour. There is not the necessity to take in dog fights, gossiping, and the like, which is very detrimental to a continuous and strenuous output. In the mines, where it is night all the time, no difference in the rate of production is noticed, and here we find a little point which is of value to the foundry. One of the chief interferences with effective night work is the objection that molders on four or five day molding jobs have to letting others continue their operations. Suppose now, that the half dozen men who would be involved were given a contract to turn out the job properly, this difficulty would fall away at once, for no one has yet seen competent and friendly molders refuse to pound the sand together on the same mold. This is what we find in the mines. The particular stope may have two or three parties of men at work at the same time alternately. At a stated period their stope is measured up by the captain or engineer and a lump sum, as per contract, is handed out.

Why can this not be arranged for in the foundry? Does it come under the ban of piece work? If so, the sooner it is straightened out the better, and many a foundry can turn out fifty per cent. more work for the same floor space.

The only other objection of account we meet—that molders want to pour their own molds—is cared for by continuous pouring.

Now I predict that something along these lines will come

sooner or later, and if the foundry industry, which is looking very closely into the recent experiments with double turns, is sufficiently alert, the coming eight hour day need not be feared very much.

In concluding the labor questions mentioned, I cannot refrain from adding a few remarks on the industrial capacity of the country at large, and the foundry in particular. We only build immense plants. We are enlarging the old ones to an extent which really means further immense plants. We have them full today, and nearly deserted tomorrow. This is not political economy, and means that when the hard times do hit us, that we take work at less than cost, to keep up our organizations. Many a nice fat surplus is wiped out in the hard times. This is not right, and perhaps the three eight-hour-shifts mentioned above may help to solve the difficulty in a measure, for a smaller plant will do for the normal output, a tightening up of conditions is met with cutting out one shift, and hard times with one turn, or even less, at work, where otherwise a vast establishment will run short handed three days a week.

Already we have some nine and one half hours only of the twenty four put in at actual production, the balance of the day sees the machinery idle, while the company's notes are piling up interest. With the eight hour day things will be worse unless steps, such as I have indicated, are resorted to. We would therefore see a plant necessarily three times as great in the lay-out as need be, and practically three times the capital tied up in it, two thirds of which is doing nothing, in fact costing interest. What could not be done with this vast amount to enrich our great nation still further.

As we look over our shipping blotters and note the effect of a holiday on the month's sales, we wish there were none of them. The same may be said for many of our men in the shops. Of course, I do not mean to advocate the abolition of our holidays, but I wish to point out what it means to have many of them when taken in connection with the size and cost of a plant for a given production or tonnage per year. We can thank our stars that our most dreaded competitor of the yet distant future—Russia—has some fifty holidays in addition to ours, which means a correspondingly increased capitalization and working cost when compared with ours. No wonder that it is only a question of time when American enter-

prises there sell out to the natives or come home.

In this aspect, perhaps, we find also a reason for consolidations, as the ultimate destination of many of the plants thus absorbed is the scrap pile. It will pay us to watch developments in the way of "over-capacity" very closely, and the future may have many strange developments in store for us herein.

Perhaps the last thing to touch upon, and yet the one matter which we will meet first, is the future development of the foundry equipment. This would form a topic upon which discussions may be held by the hour. Suffice it to point out two things. The molding machine, and conveyors. Every thing else, as well as these, is wrapped up in the policy the foundry will be forced to adopt in the near future. I have outlined this policy, as I see it, in what has gone before, and need therefore add but little. Specialization means the molding machine with a vengeance. Consolidation gives the sinews of war to adapt, adopt, and force their systematic use. The breaking up of restrictions regarding apprentices means more and better men to do the other molding. Conveying systems mean the systematic production of castings, outside of the molding end, at minimum cost. Continuous molding, pouring, and in fact continuous work in the foundry based upon short hours with good pay, means getting the best efforts of the men, contented men, and a prosperous country. Naturally the study of the foundry in all its details will not cease. Standardization, improved work, uniform customs, we might say—the millenium, minus the human end, which we will never fully control or correct; all things which help to make foundrymen reasonably content with their life work—all this lies in the future for us.

But we must not be idle in the meantime. If long association with the labor end of the foundry as well as the financial, counts for anything, I feel that we must do our utmost to place within reach of the youngest apprentice the means by which he can receive a good general education as also the special one for his trade. We owe this to our nation as well as to the industry that has made our fortunes. With all the difficulties that loom up in the labor problem, I feel that we have nothing to fear from the man who from his youth is looking forward to his own home, his savings account, the education of his children as useful citizens, and his peaceful retirement when old age comes on. This man, the back bone of the

nation, has had no difficulty to realize his ambition heretofore, and will not have it in the future, as consolidations, instead of cutting him out from opportunities, will give him the chance to become a stock-holder if he desires, and by reducing the severity of hard times, keep him in steadier employment. Men of this stamp, I am glad to say, are still the vast majority of the laboring men of today. Let us help them to help themselves by education, and the future of the foundry need give us no concern.